

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets

(11) Publication number:

O 046 947

A1

(12)

## EUROPEAN PATENT APPLICATION

(21) Application number: 81106520.0

(22) Date of filing: 21.08.81

(51) Int. Cl.<sup>3</sup>: C 07 B 29/00

C 08 G 65/28, C 08 G 65/26

B 01 J 23/02, C 07 C 41/03

C 07 C 43/13, C 07 C 45/64

C 07 C 85/24, C 07 C 102/00

C 07 C 148/00, C 07 C 51/367

(30) Priority: 29.08.80 US 182723

(43) Date of publication of application:  
10.03.82 Bulletin 82/10(84) Designated Contracting States:  
BE DE FR GB SE(71) Applicant: CONOCO INC.  
1000 South Pine Street P.O. Box 1267  
Ponca City Oklahoma 74601(US)(72) Inventor: Kang, Yang  
2501 Robin Road  
Ponca City Oklahoma 74601(US)(72) Inventor: Nield, Gerald Lee  
837 Edgewood  
Ponca City OK 74601(US)(72) Inventor: Washecheck, Paul Howard  
2801 Canterbury  
Ponca City OK 74601(US)(74) Representative: Patentanwälte Dipl.-Ing. A. Grünecker,  
Dr.-Ing. H. Kinkeldey, Dr.-Ing. W. Stockmair,  
Dr. rer. nat. K. Schumann, Dipl.-Ing. P.H. Jakob, Dr. rer.  
nat. G. Bezold Maximilianstrasse 43  
D-8000 München 22(DE)

(54) Strontium and barium containing alkoxylation systems.

(57) Basic compounds and salts of strontium and barium, and the metals themselves, are used to catalyze the formation of propylene oxide, ethylene oxide and propylene oxide/ethylene oxide adducts of a variety of organic compounds. Materials containing polyols, carboxylic acids, amines, phenols, mercaptans, alkanols, and amides can be reacted to form these adducts. Reaction products have peaked distributions, low pour points, and low levels of unreacted starting materials. Reactions are normally carried out at temperatures of from about 90 to about 260°C.


EP 0 046 947 A1

STRONTIUM AND BARIUM CONTAINING  
ALKOXYLATION SYSTEMS

This invention relates to the production of alkoxyated organic compounds by reacting said compounds in the presence of barium-containing or strontium-containing catalysts or promoted barium-containing and strontium-containing catalysts. More particularly, this invention relates to the production of alkoxyated organic compounds by reacting said compounds in the presence of these catalysts with adducting materials such as ethylene oxide and propylene oxide.

The general reaction of a variety of organic material together with an adducting material such as ethylene oxide or propylene oxide to form alkoxyated materials is known in the art. For example, U.S. Patent 2,683,087 discloses that water adsorption by paper articles is improved by the use of amine adducts of ethylene oxide. Another pulp and paper use is disclosed in "Etho-Chemicals" by Armour and Company which discloses that ethoxylated resin fatty acid or ethoxylated stearic acid are incorporated in formulations used for deinking wastepaper. Redeposition of the ink particles is reduced by the use of these surfactants and stabilizers. British Patent 847,714 teaches the processing of pre-hydrolyzed sulfate wood pulp into viscose by incorporating a propylene oxide/ethylene oxide adduct of ethylene diamine. French Patent 1,122,729 discloses the use of an acylarylpolyglycol adduct to the viscose pulp or slurry. U.S. Patent 2,392,103 shows the use of alkyl thioether adducts to viscose pulp. British Patent 815,508 discloses the addition to viscose pulp of an adduct containing at least 7 moles of ethylene oxide per mole of an aliphatic acid, amide, or aldehyde. Elöd, et al discloses the advantages obtained from using various surfactants during the preparation of viscose.

Belgium Patent 555,529 discloses an anti-static agent for synthetic fibers which is produced by esterifying one mole of lauric acid with one mole of an ethoxylated glycerol. British Patent 763,215 suggests ethoxylated organic sulfamides as anti-static agents for textiles. British Patent 779,491 discloses anti-static treatment of textiles with an ether, amine, or thioether adduct having a mole



weight of at least 2000 plus a sulfated fatty acid salt or its ester. British Patent 774,035 discloses that dyeing of wool with metal complex dyes is improved in the presence of an anionic surfactant and an alkylene oxide adduct such as  
5 60 etho-stearic acid amide. British Patent 738.379 discloses that textiles are impregnated against soiling with a solution of a stearic acid adduct of about 6000 molecular weight.

British Patent 705,117 discloses an emulsifier combination for pesticides comprising a mixture which includes:  
10 a tall oil or dodecyl mercaptan adduct. British Patent 858.687 teaches emulsifiable concentrates of pentachloropheno: which includes 1 to 5% of 3 etho-alkyl propylene diamines. U.S. Patent 2,552,187 shows emulsifiable concentrates compris: a biologically active agent, an alkyl mercaptan adduct,  
15 and other materials.

Polyol ethoxylates find uses in foods and feeds. As an example. U.S. Patent 2,674,534 discloses the use of sorbitol laurate and sorbitol oleate adducts in the coating of ice cream bars. The use of ethoxylated fatty acids such  
20 as 8 etho-coco fatty acid has been recognized as a feed additive to accelerate animal growth.

Alkylene oxide adducts are also used in the leather industry in formulations for tanning, dyeing, and lubricating leathers. U.S. Patent 2,893,811 shows the use of 12 to 18  
25 carbon atom etho-fatty amines for dyeing of vegetable-tanned leathers. U.S. 2,946,649 shows that adducts of higher molecular weight sulfonamides are effective tanning agents.


Adducts of these materials also have a variety of uses in metal working industries. Ester, ether, and amine  
30 adducts are the products used most frequently. Cleaning of metal via degreasing using alkali is practiced extensively. Because of the low foaming characteristics, adducts of esters, ethers, and amines are preferred over many other agents when metals are sprayed by alkaline media. Efficiency  
35 of a degreasing bath is improved by the addition of a lauric acid adduct.

STRONTIUM AND BARIUM CONTAINING  
ALKOXYLATION SYSTEMS

This invention relates to the production of alkoxyated organic compounds by reacting said compounds in the presence of barium-containing or strontium-containing catalysts or promoted barium-containing and strontium-containing catalysts. More particularly, this invention relates to the production of alkoxyated organic compounds by reacting said compounds in the presence of these catalysts with adducting materials such as ethylene oxide and propylene oxide.

The general reaction of a variety of organic material together with an adducting material such as ethylene oxide or propylene oxide to form alkoxyated materials is known in the art. For example, U.S. Patent 2,683,087 discloses that water adsorption by paper articles is improved by the use of amine adducts of ethylene oxide. Another pulp and paper use is disclosed in "Etho-Chemicals" by Armour and Company which discloses that ethoxylated resin fatty acid or ethoxylated stearic acid are incorporated in formulations used for deinking wastepaper. Redeposition of the ink particles is reduced by the use of these surfactants and stabilizers. British Patent 847,714 teaches the processing of pre-hydrolyzed sulfate wood pulp into viscose by incorporating a propylene oxide/ethylene oxide adduct of ethylene diamine. French Patent 1,122,729 discloses the use of an acylarylpolyglycol adduct to the viscose pulp or slurry. U.S. Patent 2,392,103 shows the use of alkyl thioether adducts to viscose pulp. British Patent 815,508 discloses the addition to viscose pulp of an adduct containing at least 7 moles of ethylene oxide per mole of an aliphatic acid, amide, or aldehyde. Elöd, et al discloses the advantages obtained from using various surfactants during the preparation of viscose.

Belgium Patent 555,529 discloses an anti-static agent for synthetic fibers which is produced by esterifying one mole of lauric acid with one mole of an ethoxylated glycerol. British Patent 763,215 suggests ethoxylated organic sulfamides as anti-static agents for textiles. British Patent 779,491 discloses anti-static treatment of textiles with an ether, amine, or thioether adduct having a mole



the product distribution curve which could contribute significantly to the intrinsic value of the adducts produced.


It is therefore an object of the present invention to provide a catalyst and method for obtaining alkoxylated adducts of a variety of organic materials using strontium-  
5 containing and/or barium-containing catalysts. Other objects will become apparent to those skilled in this art as the description proceeds.

It has now been discovered according to the present  
10 invention that materials selected from the group consisting of polyols, aldehydes, ketones, amides, amines, acids, and mercaptans can be alkoxylated by contacting these materials with an alkoxylating agent in the presence of a catalyst selected from the group consisting of strontium metal,  
15 barium metal, strontium oxide, barium oxide, strontium hydroxide, hydrated strontium hydroxide, barium hydroxide, hydrated barium hydroxide, strontium hydride, barium hydride, or mixtures of these wherein the alkoxylation is carried out at temperatures of from about 90°C to about 260°C.

The process of the instant invention can be carried  
20 out at ambient pressure. However, pressures up to about 100 pounds per square inch gauge, (psig) can also be used. Pressures below about 60 psig are preferred. Pressures below ambient can also be used but are not preferred. It is  
25 clear that while pressure or lack of pressure is not a detriment to the process of the present invention, it is simply more convenient to carry out the reaction in the pressure range of from about atmospheric to about 100 psig.

The instant invention is normally carried out at  
30 temperatures of from about 120°C to about 260°C. However, for practical purposes commercial operations will normally be carried out in a temperature range of from about 150°C to about 200°C. Temperatures in the range of from about 160°C to about 190°C are most preferred.

35 Reactions can be carried out in the presence of any alkoxylating agent which produces a mole adduct of the sort desired. Normally such agents are alpha or beta alkylen



Ethylene oxide adducts such as sorbitan monostearate adducts have been found useful in pharmaceutical and cosmetic preparations and are used to provide activities such as drug carriers, emulsifiers, and solublizers. Some adducts have their own pharmacological actions.


Oleic acid adducts plus other substances impart mechanical and chemical stability to latex rubber.

U.S. Patent 3,088,796 discloses a formulation which imparts protection to metal surfaces against corrosion by a flowing stream, one component of such formulations being an ethoxylated alkylamine. U.S. Patent 3,060,132 discloses that a Ziegler catalyst can be modified to prevent the loss of activity on storage by the addition of etho-dodecyl mercaptan.

German 1,142,465 discloses that polyglycol esters derived from reacting ethylene oxide and/or propylene oxide with aliphatic or aromatic carboxylic acids prevents carburetor icing when added to gasoline. Other uses for alkylene oxide and propylene oxide adducts are given in Schonfeldt, Surface Active Ethylene Oxide Adducts, Pergamon Press, Oxford England, 1969 pages 386 through 631.

These reactions are normally carried out using alkaline catalysts, which invariably produce a distribution of various adducts. In surfactant applications, an adduct containing too few adducting molecules is not effective because of poor solubility, while one with too many adducting molecules is undesirable because surface tension reduction per unit mass decreases drastically as the molecular weight increases. Therefore, most desirable adducts deal with as sharp a distribution in the desired mole adduct range as possible. Normally, an acid catalyzed reaction will produce such alkoxylates, but such catalysts also produce higher levels of harmful side products which must be separated and removed prior to use.

Therefore, great benefit would be provided by a catalyst system which provides low by-product levels while retaining the desired mole-adduct distribution of acid catalysts. Such catalysts could promote the narrowing of

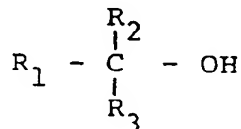


When used, these catalyst mixtures can be used in any desired effective quantity. However, the larger the quantity used, the more quickly the reaction goes to completion. Larger quantities do not appear to significantly alter the distribution obtained. For practical purposes, normally at least about 0.1% strontium or barium catalyst, based on the weight of the material to be reacted is present in the reaction, but up to about 5 weight percent is commonly used. Most commercial reactions will use from about 0.1 to about 2.0 weight percent based on the weight of the material to be reacted.

The amount of promoter or co-catalyst which should be present with a strontium or barium-containing catalyst is generally an effective amount. The effect of the co-catalyst or promoter becomes significant at somewhat above 0.1% by weight based on the weight of the material to be reacted. It is logical to expect an upper limit after which any promoter present produces no additional benefits. Normally, these materials are added to the strontium or barium catalysts in amounts ranging from about 0.1 to about 2% by weight based upon the weight of the material to be reacted. It is very apparent that these limits can be varied substantially.

While the instant invention is effective with all classes of polyols, aldehydes, ketones, amines, amides, acids, and mercaptans, it is preferred that the instant invention alkoxylate materials be selected from the group consisting of

- a) polyols having boiling points above 100°C, a total of 2 to 30 carbon atoms and having 2 or more adjacent or non-adjacent hydroxyl containing moieties of the general formula



wherein  $\text{R}_1$ ,  $\text{R}_2$ , and  $\text{R}_3$  are, independently, linear or branched acyclic groups, alicyclic groups, aryl

oxides. In most commercial operations either ethylene oxide, propylene oxide or mixtures of these will be used to produce an adduct. Of these products, ethylene oxide is most preferred.


Reaction products can have any desired content of alkoxyating agents such as ethylene oxide, but will normally range from about 30 to about 80% content of ethoxyating agent based on weight. For most purposes, the content of alkoxyating agent will range from about 40% to about 70% by weight. The amount of such materials present in the reaction is not critical other than the minimum amount necessary to provide sufficient units to reach the mole adduct level desired for the material being reacted.

The strontium-containing and barium-containing catalysts of the present invention are basic catalysts which provide the benefits of such catalysts while greatly reducing the amount of unreacted materials and undesirable by-products normally found in sharp distribution reactions. In addition, the instant invention provides that effective amounts of promoters can be added to the strontium-containing and barium-containing catalysts. These promoters are selected from the group consisting of phenols, acids, amines, amides, aldehydes, polyols, ketones, or alcohols in order to further reduce by-product reactions and to reduce or eliminate any induction periods necessary for alkoxylation to begin.

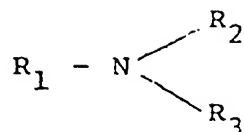
Representative examples of strontium-containing materials are strontium metal, strontium hydride, strontium oxide, strontium hydroxide, and strontium hydroxide. $\text{XH}_2\text{O}$  where X represents the number of water molecules present.

Representative examples of barium-containing materials are barium metal, barium hydride, barium oxide, barium hydroxide, and barium hydroxide. $\text{XH}_2\text{O}$  where X represents the number of water molecules present.

Many of the strontium and barium compounds alone are active in the process of the present invention and are extremely active when used with an effective amount of a co-catalyst or a promoter. Mixtures of these catalysts can be used.

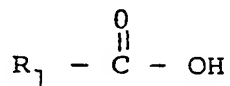






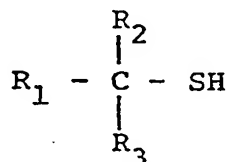
wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more functionalities selected from the group consisting of hydroxyl, ether, carbonyl, halogen, carboxyl, nitro, or amide; and

- e) organic acids having boiling points above  $100^\circ\text{C}$ , a total of 1 to 30 carbon atoms and having 1 or more adjacent or non-adjacent carboxylic acid containing moieties of the general formula



wherein  $R_1$  is hydrogen, a linear or branched acyclic group, alicyclic group, cyclic group, or aryl group, and wherein the R group can in addition contain one or more functionalities selected from the group consisting of carbonyl, hydroxyl, halogen, ether, nitro, amine, or amide.

- f) mercaptans of the general formula

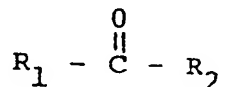


wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, aryl groups, or cyclic groups, and wherein the R-designated groups can in addition contain functional groups selected from the group consisting of halogen, nitro, carboxyl, amine, carbonyl, ether, and amide.

It has also been discovered that the present invention can be carried out even more efficiently and rapidly in the presence of a catalyst promoter. The catalyst promoter can be materials which are added to an alkoxylation system together with the catalyst or catalysts of choice. Representative examples

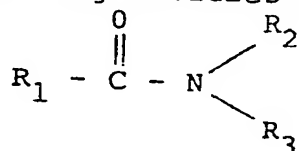
groups, cyclic groups, or hydrogen, and wherein the R-designated groups can in addition contain one or more functional groups selected from the group consisting of ether, amine, carboxyl, halogen, nitro, carbonyl, and amide;

- b) aldehydes and ketones having boiling points above 100°C, a total of from 2 to 30 carbon atoms, and having one or more adjacent or non-adjacent carbonyl containing moieties of the general formula



wherein  $R_1$  and  $R_2$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more functionalities selected from the group consisting of carboxyl, hydroxyl, ether, halogen, nitro, amine, or amide;

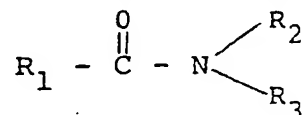
- c) primary, secondary, or tertiary amides having boiling points above 100°C and a total of from 1 to 30 carbon atoms and containing 1 or more amide containing moieties of the general formula



wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more other functionalities selected from the group consisting of hydroxyl, ether, carboxyl, carbonyl, amine, nitro, or halogen;

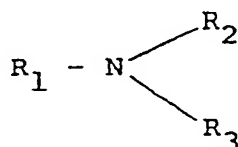
- d) primary, secondary, or tertiary amines having a boiling point above 100°C, a total of from 1 to 30 carbon atoms and having 1 or more amine containing moieties of the general formula

- c) primary, secondary, or tertiary amides having boiling points above 100°C, a total of from 1 to 30 carbon atoms and containing 1 or more amide containing moieties of the general formula



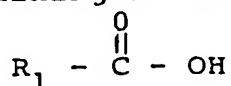
- wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups and wherein the R-designated groups can in addition contain one or more other functionalities selected from the group consisting of hydroxyl, ether, carboxyl, carbonyl, amine, nitro, or halogen;

- d) primary, secondary, or tertiary amines having boiling points above 100°C, a total of 1 to 30 carbon atoms and containing 1 or more amine containing moieties of the general formula



- wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more functionalities selected from the group consisting of hydroxyl, ether, carbonyl, halogen, carboxyl, nitro, or amide; and

- e) organic acids having boiling points above 100°C, a total of 1 to 30 carbon atoms and having 1 or more adjacent or non-adjacent carboxylic acid containing moieties of the general formula

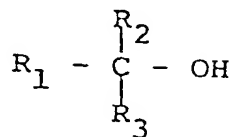


wherein  $R_1$  is hydrogen, a linear or branched acyclic group, alicyclic group, cyclic group, or

catalyst promoters useful in the process of the present invention are polyols, aldehydes, ketones, amides, amines, acids, phenols, mercaptans, and alcohols, wherein the alkoxylation is carried out at a temperature of from about 90°C to about 260°C.

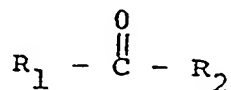
Useful promoters for the strontium-containing and barium-containing catalysts of the present invention are

- a) polyols having boiling points above 100°C, a total of 2 to 30 carbon atoms and having 2 or more adjacent or non-adjacent hydroxyl containing moieties of the general formula



wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, linear or branched acyclic groups, alicyclic groups, aryl groups, cyclic groups, or hydrogen, and wherein the R-designated groups can in addition contain one or more functional groups selected from the group consisting of ether, amine, carboxyl, halogen, nitro, carbonyl, and amide;

- b) aldehydes and ketones having boiling points above 100°C, a total of from 2 to 30 carbon atoms and having one or more adjacent or non-adjacent carbonyl containing moieties of the general formula




wherein  $R_1$ ,  $R_2$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more functionalities selected from the group consisting of carboxyl, hydroxyl, ether, halogen, nitro, amine, or amide;

out, the desired amount of catalyst is reacted with an effective amount of promoter for a period of time ranging up to about 4 hours up to about 200°C. Normally however, such preforming or prereaction will be carried out at  
5 temperatures of from about 25°C to about 160°C for periods of time ranging from about 0.5 to about 2.5 hours. Such preformed catalysts can be isolated and recovered or in the preferred embodiment simply added as a reaction mixture to the major alkoxylation reaction. Many of the materials  
10 susceptible to alkoxylation reactions using the catalyst of the present invention are also effective promoters, both with each other and with other groups of materials.

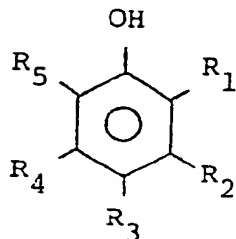
Representative examples of various polyol reactants and/or promoters effective in the process of the present invention  
15 are

ethylene glycol  
1,2-propylene glycol  
1,4-butanediol  
1,6-hexanediol  
20 1,10-decanediol  
1,3-butylene glycol  
diethylene glycol  
diethylene glycol monobutyl ether  
diethylene glycol monomethyl ether  
25 diethylene glycol monoethyl ether  
dipropylene glycol  
dipropylene glycol monomethyl ether  
ethylene glycol monomethyl ether  
ethylene glycol monoethyl ether  
30 ethylene glycol monobutyl ether  
hexylene glycol  
pentaerythritol  
dipentaerythritol  
tripentaerythritol  
35 trimethylolpropane  
trimethylolethane  
neopentyl glycol  
diethanolamine  
triethanolamine



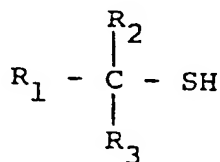
aryl group, and wherein the R group can in addition contain one or more functionalities selected from the group consisting of carbonyl, hydroxyl, halogen, ether, nitro, amine, or amide;

- f) phenols having boiling points of above 100°C, a total of from 6 to 30 carbon atoms and having 1 or more functionalities of the general formula



wherein  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ , and  $R_5$  are, independently, hydrogen, halogen, hydroxyl, nitro, ether, or carbonyl, linear or branched acyclic groups, alicyclic groups, cyclic groups, aryl groups, or substituted aryl groups, and wherein in addition the R-designated groups can contain one or more functionalities selected from the group consisting of halogen, ether, nitro, carboxyl, carbonyl, amine, amide, or hydroxyl, (primary and secondary, linear and branched); and

- g) mercaptans of the general formula



wherein  $R_1$ ,  $R_2$  and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more functionalities selected from the group consisting of carboxyl, hydroxyl, ether, halogen, nitro, amine, or amide;

In some cases it is advantageous to preform or prereact the catalyst promoter with the catalyst prior to addition to the alkoxylation system. When this is carried

decyl aldehyde  
p-methoxybenzaldehyde  
p-aminobenzaldehyde  
phenylacetaldehyde  
5 acetoacetic acid  
2,5-dimethoxybenzaldehyde  
1-naphthyl aldehyde  
terephthaldehyde

Representative examples of various amides useful  
10 in the process of the instant invention are  
formamide  
benzamide  
acetanilide  
salicylamide  
15 acetoacetanilide  
ortho-acetoacetotoluidide  
acrylamide  
N,N-diethyltoluamide  
N,N-dimethylacetamide  
20 N,N,-dimethylformamide  
phthalimide  
octylamide  
decylamide  
laurylamide  
25 stearylamide  
N,N-dimethylollaurylamide  
N,N-dimethylacrylamide  
para-chlorobenzamide  
para-methoxybenzamide  
30 para-aminobenzamide  
para-hydroxybenzamide  
ortho-nitrobenzamide  
N-acetyl-para-aminophenol  
2-chloroacetamide  
35 oxamide  
N,N-methylene-bis-acrylamide  
dodecylamide

diisopropanolamine  
 triisopropanolamine  
 1,4-dimethylolcyclohexane  
 2,2-bis(hydroxymethyl)propionic acid  
 5 1,2-bis(hydroxymethyl)benzene  
 4,5-bis(hydroxymethyl)furfural  
 4,8-bis(hydroxymethyl)tricyclo[5,2,1,0] decane  
 tartaric acid  
 2-ethyl-1,3-hexanediol  
 0 2-amino-2-ethyl-1,3-propanediol  
 triethylene glycol  
 tetraethylene glycol  
 glycerol  
 ascorbic acid, and  
 5 sugar alcohols selected from the group consisting of erythritol,  
 dulcitol, sorbitol, mannitol and lanolin

Representative examples of various aldehydes and ketone reactants and/or promoters effective in the process of the instant invention are

) lauryl aldehyde  
 benzaldehyde  
 2-undecanone  
 acetophenone  
 2,4-pentanedione  
 i acetylsalicylic acid  
 ortho-chlorobenzaldehyde  
 para-chlorobenzaldehyde  
 cinnamic aldehyde  
 diisobutyl ketone  
 i ethyl acetoacetate  
 ethylamyl ketone  
 camphor  
 para-hydroxybenzaldehyde  
 2-carboxybenzaldehyde  
 4-carboxybenzaldehyde  
 salicylaldehyde  
 octyl aldehyde






N,N-diethylaniline  
diethylenetriamine  
diisopropanolamine  
N,N-dimethylethanolamine  
5 N,N-dimethylaniline  
2,4-dinitroaniline  
diphenylamine  
ethyl para-aminobenzoate  
N-ethylethanolamine  
10 N-ethyl-1-naphthylamine  
N-ethyl-ortho-toluidine  
N-ethylaniline  
ethylenediamine  
hexamethylenetetraamine  
15 2,4-lutidine  
N-methylaniline  
methyl anthranilate  
p,p'-diaminodiphenylmethane  
ortho-nitroaniline  
20 para-nitroaniline  
tert-octylamine  
piperazine  
ethanolamine  
isopropanolamine  
25 ortho-toluidine  
para-toluidine  
2,4-toluylenediamine  
triethanolamine  
tributylamine  
30 triisopropanolamine  
2,4-dimethylxylylidine  
para-methoxyaniline  
nitrilotriacetic acid  
N-phenyl-1-naphthylamine  
35 decylamine  
dodecylamine  
tetradecylamine

tetradecylamide  
hexadecylamide  
octadecylamide  
octadecenylamide

Representative examples of various amines useful in the process of the instant invention are

aniline  
benzylamine  
hexadecylamine  
triphenylamine  
aminoacetic acid  
anthranilic acid  
cyclohexylamine  
tert-octylamine  
ortho-phenylenediamine  
meta-phenylenediamine  
para-phenylenediamine  
N-acetyl-para-aminophenol  
2-amino-4-chlorophenol  
2-amino-2-ethyl-1,3-propanediol  
ortho-aminophenol  
para-aminophenol  
para-aminosalicylic acid  
benzyl-N,N-dimethylamine  
tert-butylamine  
2-chloro-4-aminotoluene  
6-chloro-2-aminotoluene  
meta-chloroaniline  
ortho-chloroaniline  
para-chloroaniline  
4-chloro-2-nitroaniline  
dibutylamine  
2,5-dichloroaniline  
3,4-dichloroaniline  
dicyclohexylamine  
diethanolamine  
N,N-diethylethanolamine  
N,N-diethyl-meta-toluidine




- glycolic acid
- malic acid
- maleic acid
- cinnamic acid
- 5 para-hydroxybenzoic acid
- methacrylic acid
- oxalic acid
- myristic acid
- palmitic acid
- 10 tert-pentanoic acid
- phenylacetic acid
- mandelic acid
- sebacic acid
- tallow fatty acids
- 15 hydrogenated tallow fatty acids
- tartaric acid
- trichloroacetic acid
- 2,4,5-trichlorophenoxyacetic acid
- undecylenic acid
- 20 crotonic acid
- pelargonic acid
- acetoacetic acid
- para-nitrobenzoic acid
- ascorbic acid
- 25 nitrilotriacetic acid
- naphthenic acids
- 1-naphthoic acid
- trimellitic acid

- Representative examples of various mercaptans in the
- 30 process of the instant invention are
  - dodecyl mercaptan
  - t-dodecyl mercaptan
  - isodecyl mercaptan
  - octyl mercaptan
  - 35 octadecyl mercaptan

hexadecylamine  
octadecylamine  
octadecenylamine  
dilaurylamine  
N-ethyl laurylamine

Representative examples of various acids useful in the process of the instant invention are

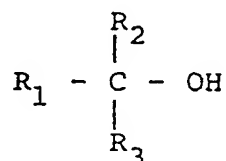
formic acid  
acetic acid  
valeric acid  
heptanoic acid  
2-ethylhexanoic acid  
lauric acid  
stearic acid  
oleic acid  
tall oil acids  
hydrogenated tall oil acids  
benzoic acid  
salicylic acid  
adipic acid  
azelaic acid  
fumaric acid  
citric acid  
acrylic acid  
aminoacetic acid  
para-aminosalicylic acid  
anthranilic acid  
butyric acid  
propionic acid  
ricinoleic acid  
chloroacetic acid  
ortho-chlorobenzoic acid  
2,4-dichlorophenoxyacetic acid  
tert-decanoic acid  
para-aminobenzoic acid  
abietic acid  
itaconic acid  
lactic acid



ortho-nitrophenol  
para-phenylphenol  
phenyl salicylate  
salicylaldehyde  
5 p-hydroxy benzaldehyde  
2-amino-4-chlorophenol  
ortho-aminophenol  
salicylamide  
2,4-dichlorophenol  
10 2,5-dichlorophenol  
2,5-dichlorohydroquinone

Certain alcohols can also act as promoters for ethoxylation of organic material using strontium-containing or barium-containing catalysts. Such alcohols are more  
15 acidic than normal alcohols such that the association constant is greater (or the pKa is lower) than normal alcohols. Thus, these alcohol promoters would have a pKa less than 17.

These alcohols are those containing a hydroxyl group and having the formula



20 wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, aryl groups, or cyclic groups, and wherein the R-designated groups can in addition contain functional groups selected from the group consisting of halogen, nitro, carboxyl, amine, carbonyl,  
25 ether, and amide. The molecule can contain a total of from 2 to 30 carbon atoms.

Representative examples of these effective alcohol promoters are:

triphenylmethanol  
30 trichloroethanol  
trifluoroethanol  
2-nitroethanol

Representative examples of various phenols which are promoters for the catalysts of the present invention are

phenol  
ortho-cresol  
meta-cresol  
2,4-dimethylphenol  
2,5-dimethylphenol  
2,6-dimethylphenol  
para-cresol  
ortho-chlorophenol  
meta-chlorophenol  
para-chlorophenol  
para-nitrophenol  
para-methoxyphenol  
salicylic acid  
meta-hydroxyacetophenone  
para-aminophenol  
ortho-phenylphenol  
nonylphenol  
octylphenol  
t-butyl-para-cresol  
hydroquinone  
catechol  
resorcinol  
pyrogallol  
1-naphthol  
2-naphthol  
4,4'-isopropylidenediphenol (bisphenol A)  
methyl salicylate  
benzyl salicylate  
4-chloro-2-nitrophenol  
para-t-butylphenol  
2,4-di-t-amylphenol  
2,4-dinitrophenol  
para-hydroxybenzoic acid  
8-hydroxyquinoline  
methyl para-hydroxybenzoate  
2-nitro-para-cresol



2-chloroethanol  
2,2-dichloroethanol  
2-methoxyethanol  
2-chlorocyclohexanol  
ortho-chlorobenzyl alcohol

The invention is more concretely described with reference to the examples below wherein all parts and percentages are by weight unless otherwise specified. The examples are provided to illustrate the instant invention and not to limit it.

#### Example 1


A 600 cubic centimeter (cc) stainless steel reactor was charged with 120 grams of heptanoic acid and 3.2 grams  $\text{Sr}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$  catalyst. After purging with nitrogen at 50 cc per minute for one hour at  $150^\circ\text{C}$ , the reactor was evacuated and the temperature raised to about  $175^\circ\text{C}$ . Ethylene oxide (EO) was then introduced to a total pressure of about 40 psig and EO uptake of 92.6 grams was allowed to proceed at this pressure. Ethoxylation was completed in 300 minutes after which the catalyst was neutralized.

#### Example 2

Example 1 was repeated except that 2 grams of barium hydroxide  $\cdot \text{H}_2\text{O}$  was used as catalyst. Ethylene oxide uptake of 180 grams was completed in 93 minutes. The catalyst was neutralized and the resulting ethoxylate product had a pour point of  $-60^\circ\text{F}$ .

#### Example 3

An experiment was carried out as described in example 2 except that 1 gram barium hydroxide  $\cdot \text{H}_2\text{O}$  catalyst and 0.65 grams benzamide co-catalyst were used. Dehydration was accomplished by one hour of nitrogen purging at a rate of 50 to 100 cc per minute as the temperature increased from  $100^\circ\text{C}$  to  $130^\circ\text{C}$ . The reactor was then evacuated to 100 millimeters (mm) mercury at  $130^\circ\text{C}$ . EO uptake was completed in 123 minutes after which the catalyst was neutralized. The product had a pour point of  $-60^\circ\text{F}$ .



**THIS PAGE BLANK (USPTO)**



## Example 4

An experiment was carried out as described in example 1 except that 120 grams stearic acid (Hydrex 450, trademark of and sold by HUMKO Products, a division of KRAFTCO Corp) was used instead of heptanoic acid. After purging with nitrogen at 250cc per minute for one hour at 150°C, the reactor was evacuated and the temperature raised to about 178°C. EO addition of 61.3 grams was completed in 300 minutes after which the catalyst was neutralized.

## Example 5

An experiment was carried out as described in Example 4 except that the catalyst was 3.2 grams of a preformed mixture of strontium hydroxide. $8H_2O$  (10.0 grams), phenol (7.8 grams), and water (17.8 grams). EO addition of 44 grams was completed in 315 minutes after which time the catalyst was neutralized.

## Example 6

An experiment was carried out as described in example 2 except that 120 grams 2-ethylhexanoic acid was ethoxylated. One gram of barium hydroxide. $H_2O$  and benzamide (1.13 grams) were used as co-catalysts. The nitrogen purge rate was 100 cc per minute for dehydration. EO addition at 180 grams was completed in 73 minutes. The catalyst was neutralized to yield a product having a pour point of -60°F.

## Example 7

An experiment was carried out as described in example 6 except that the co-catalyst was strontium hydroxide. $8H_2O$  (3.2 grams) and 1,2-propanediol (1.82 grams). EO addition of 110.9 grams was completed in 305 minutes.

## Example 8

An experiment is carried out as described in example 7 except that co-catalysts are strontium hydroxide. $8H_2O$  (3.2 grams) and heptanoic acid (3.1 grams). EO addition is accomplished in about 300 minutes.

## Example 9

A 600 cubic centimeter stainless steel reactor was charged with 150 grams propylene glycol, 0.5 grams barium

hydroxide .H<sub>2</sub>O and 0.42 grams nonanoic acid. After purging with nitrogen at 250cc per minute for 1 hour at 150°C, the reactor was evacuated and the temperature raised to about 178°C. 150 grams of ethylene oxide was added over 42 minutes at a reactor pressure of about 40 psig. The catalyst was neutralized to yield a product having a pour point of -60°F.

#### Example 10

An experiment was carried out as described in example 9 except that co-catalysts used were 2.0 grams barium hydroxide.H<sub>2</sub>O and 2.0 grams phenol. Ethylene oxide addition was completed in 25 minutes. Pour point of the product was -50°F after neutralization.

#### Example 11

An experiment was carried out as described in example 9 except that the reactor was charged with 60 grams of glycerol, 0.5 grams of barium hydroxide.H<sub>2</sub>O, and 0.5 grams phenol. After purging, evacuation and heating to 178°C, propylene oxide (PO) was added to the reactor to a pressure of about 40 psig. Addition of 240 grams of PO was completed in 145 minutes. Pour point of the neutralized product was -15°F. Viscosities were 96.7 centistokes at 40°C and 8.17 centistokes at 100°C.

#### Example 12

An experiment was carried out as described in example 11 except that the reactor was charged with 10.0 grams glycerol, 1.0 grams barium hydroxide.H<sub>2</sub>O, and 1.0 gram phenol. PO addition of 290 grams was completed in 207 minutes. The product had a pour point of -40°F and viscosities of 146.7 and 23.2 centistokes at 40°C and 100°C respectively.

#### Example 13

An experiment was carried out as described in example 9 except that the reactor was charged with 60 grams glycerol, 2.0 grams strontium hydroxide.8H<sub>2</sub>O, and 1.82 grams benzamide. Addition of 240 grams EO was completed in 43 minutes. Pour point of the product was -35°F.



## Example 14

An experiment was carried out as described in example 9 except the reactor was charged with 60 grams glycerol, 0.5 grams barium hydroxide. $\text{H}_2\text{O}$ , and 0.57 grams benzylamine. Addition of 240 grams EO was completed in 71 minutes. Pour point of the product was  $-75^\circ\text{F}$ .

## Example 15

An experiment was carried out as described in example 9 except the reactor was charged with 60.0 grams sorbitol, 2.0 grams strontium hydroxide. $8\text{H}_2\text{O}$ , and 1.28 grams 2-undecanone. Addition of 240 grams of EO was completed in 127 minutes. The product pour point was  $-15^\circ\text{F}$ .

## Example 16


An experiment was carried out as described in example 9 except the reactor was charged with sorbitol (60.0 grams), barium hydroxide. $\text{H}_2\text{O}$  (1.0 grams), and benzaldehyde (1.12 grams). At a reaction temperature of  $178^\circ\text{C}$ , ethylene oxide addition was completed to the extent desired at a reactor pressure of about 40 psig.

## Example 17

An experiment was carried out as described in example 9 except the reactor was charged with 150 grams propylene glycol, barium hydroxide. $\text{H}_2\text{O}$  (0.5 grams), and glycerol (0.24 grams).

## Example 18

A stainless steel reactor having 600 cc capacity was charged with 120 grams benzylamine, 2.0 grams barium hydroxide  $\text{H}_2\text{O}$ , and 2.0 grams phenol. The reaction mass was purged with nitrogen at 50 cc per minute for one hour at  $150^\circ\text{C}$ . The reactor was then evacuated and temperature raised to about  $178^\circ\text{C}$ . 180 grams of ethylene oxide was added over 49 minutes at a reactor pressure between 20 and 40 psig. The catalyst was neutralized and the product had a pour point of  $-10^\circ\text{F}$ .



Example 19

An experiment was carried out as described in example 18 except the reactor was charged with 150 grams benzylamine, 2.0 grams strontium hydroxide. $8H_2O$ , and 2.2 grams 2-ethylhexanoic acid.

Example 20

5 An experiment is carried out as described in example 18 except the reactor is charged with 150 grams benzylamine, 2.0 grams barium hydroxide. $H_2O$  and 1.6 grams propylene glycol.

Example 21

10 An experiment was carried out as described in example 9 except the reactor was charged with 120 grams benzamide, 1.6 grams strontium hydroxide. $8H_2O$ , and 1.2 grams phenol. Addition of 113.5 grams EO was completed in 210 minutes.

15 Example 22

An experiment is carried out as described in example 21 except the reactor is charged with 120 grams benzamide, 2.0 grams barium hydroxide. $H_2O$ , and 3.0 grams 2-ethyl hexanoic acid.

Example 23

20 An experiment is carried out as described in example 21 except the reactor is charged with 120 grams benzamide, 2.0 grams barium hydroxide. $H_2O$ , and 1.6 grams 1,2-propanediol.

Example 24

25 A 600 cc stainless steel reactor was charged with 120 grams of 1-dodecanethiol, 0.6 grams barium hydroxide. $H_2O$ . After purging with nitrogen at 250cc per minute for 1 hour at 150°C, the reactor was evacuated and the temperature raised to about 170°C. EO was then introduced to a total  
30 pressure of about 40 psig and EO uptake of 180 grams was allowed to proceed at this pressure. Ethoxylation was completed in 55 minutes after which the catalyst was neutralized. The product had a pour point of 50°F and contained 2.3% unreacted 1-dodecanethiol.

Example 25

An experiment was carried out as described in example 24 except the reactor was charged with 78 grams of 1-dodecanethiol and 0.6 grams barium hydroxide. $\text{H}_2\text{O}$ . Addition of 117 grams of ethylene oxide was completed in 20 minutes. The product had a pour point of 60°F.

Example 26

An experiment was carried out as described in example 18 except the reactor was charged with 89 grams of lauryl aldehyde, 3.2 grams of strontium hydroxide. $8\text{H}_2\text{O}$ , and 3.1 grams heptanoic acid. EO addition of 133.5 grams was completed in 150 minutes.

Example 27

An experiment is carried out as described in example 26 except the reactor is charged with 100 grams lauryl aldehyde, 3.0 grams barium hydroxide. $\text{H}_2\text{O}$ , and 3.0 grams phenol.

Example 28

An experiment is carried out as described in example 26 except the reactor is charged with 100 grams lauryl aldehyde, 3.0 grams barium hydroxide. $\text{H}_2\text{O}$ , and 2.6 grams propylene glycol.

Example 29

As a comparative example, a stainless steel reactor having 600 cc capacity was charged with 120 grams of alcohol (ALFOL 12 alcohol, a 12 carbon alcohol trademark of and sold by Conoco Inc.) and 0.15 grams sodium hydroxide. After purging with nitrogen at 250cc per minute for 1 hour at 150°C, the reactor was evacuated and the temperature was raised to about 178°C. Propylene oxide was then introduced to a total pressure of about 40 psig and propylene oxide uptake of 94 grams was allowed to proceed at this pressure. PO addition was completed in 124 minutes. After propoxylation, the catalyst was neutralized. Pour point of the product was 0°F.

Thus the instant invention provides a method for obtaining high mole adduct alkoxylates of polyols, aldehydes,



0046947

ketones, amides, amines, acids, and mercaptans by contacting such materials with barium-containing and strontium-containing catalysts. Products obtained contain low amounts of by-products and unreacted organic materials.

5           Although exemplified as batch reactions, the catalyst and promoters of the present invention are extremely well suited to continuous reaction methods. The reaction products are of extremely high quality and quantity.

10           While certain embodiments and details have been shown for the purpose of illustrating this invention, it will be apparent to those skilled in this art that various changes and modifications may be made herein without departing from the spirit or scope of the invention.

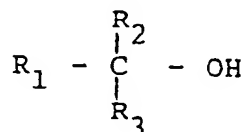
          We claim:

1. A method for the alkoxylation of a material selected from the group consisting of polyols, aldehydes, ketones, amides, amines, acids, and mercaptans, comprising contacting said material with an alkoxyating agent in the presence of at least one catalyst selected from the group consisting of strontium metal, barium metal, strontium oxide, barium oxide, strontium hydroxide, hydrated strontium hydroxide, barium hydroxide, hydrated barium hydroxide, strontium hydride, barium hydride, or mixtures of these wherein the alkoxylation is carried out at a temperature of from about 90°C to about 260°C.
2. A method as described in claim 1 wherein the alkoxyating agent is selected from the group consisting of ethylene oxide, propylene oxide, or mixtures of these.
3. A method as described in claim 2 wherein the alkylene oxide adduct ratio ranges from about 10 weight percent to about 80 weight percent based upon the total weight of the ethoxylated product.
4. A method as described in claim 3 wherein the reaction is carried out at pressures up to about 100 pounds per square inch gauge.
5. A method as described in claim 4 wherein the alkoxyating agent is ethylene oxide.
6. A method as described in claim 5 wherein the material ethoxylated is selected from the group consisting of



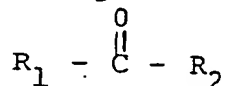
0046947

- a) polyols having a boiling point above 100°C, a total of 2 to 30 carbon atoms and having 2 or more adjacent or non-adjacent hydroxyl-containing moieties of the general formula



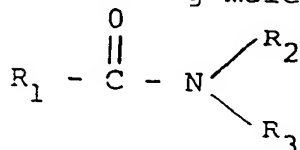
wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, linear or branched acyclic groups, alicyclic groups, aryl groups, cyclic groups, or hydrogen and wherein the R-designated groups can in addition contain one or more functional groups selected from the group consisting of ether, amine, carboxyl, halogen, nitro, carbonyl, and amide;

- b) aldehydes and ketones having boiling points above 100°C, a total of from 2 to 30 carbon atoms, and having one or more adjacent or non-adjacent carbonyl containing moieties of the general formula



wherein  $R_1$  and  $R_2$  are, independently, hydrogen linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups and wherein the R-designated groups can in addition contain one or more functionalities selected from the group consisting of carboxyl, hydroxyl, ether, halogen, nitro, amine, or amide;

- c) primary, secondary, or tertiary amides having boiling points above 100°C and a total of from 1 to 30 carbon atoms and containing one or more amide-containing moieties of the general formula

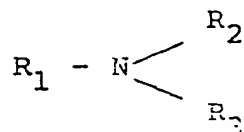


wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups,



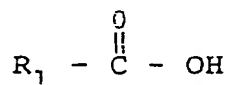
cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more other functionalities selected from the group consisting of hydroxyl, ether, carboxyl, carbonyl, amine, nitro, or halogen;

- d) primary, secondary, or tertiary amines having boiling points above 100°C, a total of from 1 to 30 carbon atoms and having one or more amine-containing moieties of the general formula



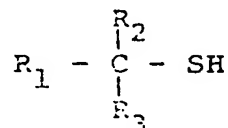
wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more functionalities selected from the group consisting of hydroxyl, ether, carbonyl, halogen, carboxyl, nitro, or amide; and

- e) organic acids having boiling points above 100°C, a total of 1 to 30 carbon atoms and having one or more adjacent or non-adjacent carboxylic acid containing moieties of the general formula



wherein  $R_1$  is hydrogen, a linear or branched acyclic group, alicyclic group, cyclic group, or aryl group, and wherein the R group can in addition contain one or more functionalities selected from the group consisting of carbonyl, hydroxyl, halogen, ether, nitro, amine, or amide;

- f) mercaptans of the general formula



wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups,

aryl groups, or cyclic groups, and wherein the R-designated groups can in addition contain functional groups selected from the group consisting of halogen, nitro, carboxyl, amine, carbonyl, ether, and amide.

5           7. A method for the alkoxylation of a material  
selected from the group consisting of polyols, aldehydes,  
ketones, amides, amines, acids, and mercaptans, comprising  
contacting said material with an alkoxyating agent in the  
presence of at least one catalyst selected from the group  
0 consisting of strontium metal, barium metal, strontium  
oxide, barium oxide, strontium hydroxide, hydrated strontium  
hydroxide, barium hydroxide, hydrated barium hydroxide,  
strontium hydride, barium hydride, or mixtures of these  
together with an effective amount of at least one catalyst  
5 promoting material selected from the group consisting of  
polyols, aldehydes, ketones, amides, amines, acids, phenols,  
mercaptans, and alcohols, wherein the alkoxylation is carried  
out at a temperature of from about 90°C to about 260°C.

0           8. A method as described in claim 7 wherein the  
alkoxyating agent is selected from the group consisting of  
ethylene oxide, propylene oxide, or mixtures of these.

5           9. A method as described in claim 8 wherein the  
alkylene oxide adduct ratio ranges from about 10 weight  
percent to about 80 weight percent based upon the total  
weight of the ethoxylated product.

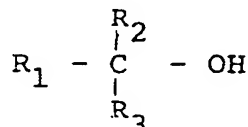
          10. A method as described in claim 9 wherein the  
reaction is carried out at pressures of up to about 100  
psig.

0           11. A method as described in claim 10 wherein the  
alkoxyating agent is ethylene oxide.



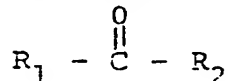
12. A method as described in claim 11 wherein the barium-containing and/or strontium-containing catalysts are promoted by materials selected from the group consisting of

- a) polyols having a boiling point above 100°C, a total of 2 to 30 carbon atoms and having 2 or more adjacent or non-adjacent hydroxyl-containing moieties of the general formula



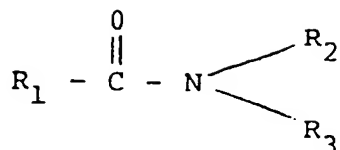
wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, linear or branched acyclic groups, alicyclic groups, aryl groups, cyclic groups, or hydrogen, and wherein the R-designated groups can in addition contain one or more functional groups selected from the group consisting of ether, amine, carboxyl, halogen, nitro, carbonyl, and amide;

- b) aldehydes and ketones having boiling points above 100°C, a total of from 2 to 30 carbon atom and having one or more adjacent or non-adjacent carbonyl-containing moieties of the general formula



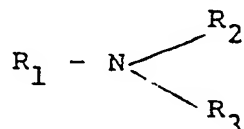
wherein  $R_1$  and  $R_2$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more functionalities selected from the group consisting of carboxyl, hydroxyl, ether, halogen, nitro, amine, or amide;

- c) primary, secondary, or tertiary amides having boiling points above 100°C, a total of from 1 to 30 carbon atoms and containing 1 or more amide-containing moieties of the general formula



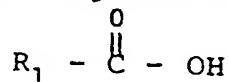
wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more other functionalities selected from the group consisting of hydroxyl, ether, carboxyl, carbonyl, amine, nitro, or halogen;

- d) primary, secondary, or tertiary amines having boiling points above 100°C, a total of 1 to 30 carbon atoms and containing one or more amine-containing moieties of the general formula



wherein  $R_1$ ,  $R_2$  and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, cyclic groups, or aryl groups, and wherein the R-designated groups can in addition contain one or more functionalities selected from the group consisting of hydroxyl, ether, carbonyl, halogen, carboxyl, nitro, or amide; and

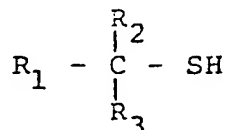
- e) organic acids having boiling points above 100°C, a total of 1 to 30 carbon atoms and having one or more adjacent or non-adjacent carboxylic acid-containing moieties of the general formula



wherein  $R_1$  is hydrogen, a linear or branched acyclic group, alicyclic group, cyclic group, or aryl group, and wherein the R group can in addition contain one or more functionalities selected from the group

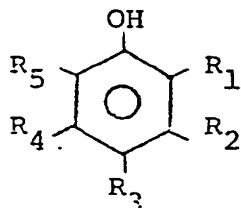
consisting of carbonyl, hydroxyl, halogen, ether, nitro, amine, or amide;

f) mercaptans of the general formula



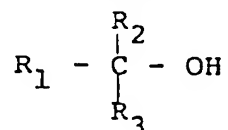
wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, aryl groups, or cyclic groups, and wherein the R-designated groups can in addition contain functional groups selected from the group consisting of halogen, nitro, carboxyl, amine, carbonyl, ether, and amide;

g) phenols having boiling points of above 100°C, a total of from 6 to 30 carbon atoms and having one or more functionalities of the general formula



wherein  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ , and  $R_5$  are, independently hydrogen, halogen, hydroxyl, nitro, ether, or carbonyl, linear or branched acyclic groups, alicyclic groups, cyclic groups, aryl groups, or substituted aryl groups, and wherein in addition the R-designated groups can contain one or more functionalities selected from the group consisting of halogen, ether, nitro, carboxyl, carbonyl, amine, amide, or hydroxyl; and

- h) alcohols containing from 2 to 30 carbon atoms of the general formula



wherein  $R_1$ ,  $R_2$ , and  $R_3$  are, independently, hydrogen, linear or branched acyclic groups, alicyclic groups, aryl groups, or cyclic groups, and wherein the R-designated groups can in addition contain functional groups selected from the group consisting of halogen, nitro, carboxyl, amine, carbonyl, ether, and amide.

13. A method as described in claim 12 wherein catalysts are combined with promoters prior to carrying out said reaction said combining carried out at temperatures of up to 200°C for a time sufficient to effect said combination.


14. A method as described in claim 12 wherein the polyol is selected from the group consisting of

ethylene glycol  
1,2-propylene glycol  
1,4-butanediol  
1,6-hexanediol  
1,10-decanediol  
1,3-butylene glycol  
diethylene glycol  
diethylene glycol monobutyl ether  
diethylene glycol monomethyl ether  
diethylene glycol monoethyl ether  
dipropylene glycol  
dipropylene glycol monomethyl ether  
ethylene glycol monomethyl ether  
ethylene glycol monoethyl ether  
ethylene glycol monobutyl ether  
hexylene glycol  
pentaerythritol  
dipentaerythritol

tripentaerythritol  
trimethylolpropane  
trimethylolethane  
neopentyl glycol  
5 diethanolamine  
triethanolamine  
diisopropanolamine  
triisopropanolamine  
1,4-dimethylolcyclohexane  
10 2,2-bis(hydroxymethyl)propionic acid  
1,2-bis(hydroxymethyl)benzene  
4,5-bis(hydroxymethyl)furfural  
4,8-bis(hydroxymethyl)tricyclo[5,2,1,0] decane  
tartaric acid  
15 2-ethyl-1,3-hexanediol  
2-amino-2-ethyl-1,3-propanediol  
triethylene glycol  
tetraethylene glycol  
glycerol  
20 ascorbic acid, and  
sugar alcohols selected from the group consisting of erythritol,  
dulcitol, sorbitol, mannitol and lanolin

15. A method as described in claim 12 wherein the  
aldehydes and ketones are selected from the group consisting  
of

25 lauryl aldehyde  
benzaldehyde  
2-undecanone  
acetophenone  
2,4-pentanedione  
30 acetylsalicylic acid  
ortho-chlorobenzaldehyde  
para-chlorobenzaldehyde  
cinnamic aldehyde  
diisobutyl ketone  
35 ethyl acetoacetate  
ethylamyl ketone



camphor  
para-hydroxybenzaldehyde  
2-carboxybenzaldehyde  
4-carboxybenzaldehyde  
5 salicylaldehyde  
octyl aldehyde  
decyl aldehyde  
p-methoxybenzaldehyde  
p-aminobenzaldehyde  
10 phenylacetaldehyde  
acetoacetic acid  
2,5-dimethoxybenzaldehyde  
1-naphthyl aldehyde  
terephthaldehyde

15 16. A method as described in claim 12 wherein the  
amides are selected from the group consisting of  
formamide

benzamide  
20 acetanilide  
salicylamide  
acetoacetanilide  
ortho-acetoacetotoluidide  
acrylamide  
25 N,N-diethyltoluamide  
N,N-dimethylacetamide  
N,N,-dimethylformamide  
phthalimide  
octylamide  
30 decylamide  
laurylamide  
stearylamide  
N,N-dimethylollaurylamide  
N,N-dimethylacrylamide  
35 para-chlorobenzamide  
para-methoxybenzamide  
para-aminobenzamide





para-hydroxybenzamide  
ortho-nitrobenzamide  
N-acetyl-para-aminophenol  
2-chloroacetamide

5 oxamide

N,N-methylene-bis-acrylamide  
dodecylamide

tetradecylamide

hexadecylamide

10 octadecylamide

octadecenylamide

17. A method as described in claim 12 wherein the  
amines are selected from the group consisting of  
aniline

15 benzylamine

hexadecylamine

triphenylamine

aminoacetic acid

anthranilic acid

20 cyclohexylamine

tert-octylamine

ortho-phenylenediamine

meta-phenylenediamine

para-phenylenediamine

25 N-acetyl-para-aminophenol

2-amino-4-chlorophenol

2-amino-2-ethyl-1,3-propanediol

ortho-aminophenol

para-aminophenol

30 para-aminosalicylic acid

benzyl-N,N-dimethylamine

tert-butylamine

2-chloro-4-aminotoluene

6-chloro-2-aminotoluene

35 meta-chloroaniline

ortho-chloroaniline



para-chloroaniline  
4-chloro-2-nitroaniline  
dibutylamine  
2,5-dichloroaniline  
5 3,4-dichloroaniline  
dicyclohexylamine  
diethanolamine  
N,N-diethylethanolamine  
N,N-diethyl-meta-toluidine  
10 N,N-diethylaniline  
diethylenetriamine  
diisopropanolamine  
N,N-dimethylethanolamine  
N,N-dimethylaniline  
15 2,4-dinitroaniline  
diphenylamine  
ethyl para-aminobenzoate  
N-ethyl ethanolamine  
N-ethyl-1-naphthylamine  
20 N-ethyl-ortho-toluidine  
N-ethylaniline  
ethylenediamine  
hexamethylenetetraamine  
2,4-lutidine  
25 N-methylaniline  
methyl anthranilate  
p,p'diaminodiphenylmethane  
ortho-nitroaniline  
para-nitroaniline  
30 tert-octylamine  
piperazine  
ethanolamine  
isopropanolamine  
ortho-toluidine  
35 para-toluidine  
2,4-toluylenediamine

triethanolamine  
tributylamine  
triisopropanolamine  
2,4-dimethylxylidine  
5 para-methoxyaniline  
nitrilotriacetic acid  
N-phenyl-1-naphthylamine  
decylamine  
dodecylamine  
10 tetradecylamine  
hexadecylamine  
octadecylamine  
octadecenylamine  
dilaurylamine  
15 N-ethylaurylamine

18. A method as described in claim 12 wherein the  
acids are selected from the group consisting of  
formic acid  
20 acetic acid  
valeric acid  
heptanoic acid  
2-ethylhexanoic acid  
lauric acid  
25 stearic acid  
oleic acid  
tall oil acids  
hydrogenated tall oil acids  
benzoic acid  
30 salicylic acid  
adipic acid  
azelaic acid  
fumaric acid  
citric acid  
35 acrylic acid  
aminoacetic acid  
para-aminosalicylic acid  
anthranilic acid

butyric acid  
propionic acid  
ricinoleic acid  
chloroacetic acid  
5 ortho-chlorobenzoic acid  
2,4-dichlorophenoxyacetic acid  
tert-decanoic acid  
para-aminobenzoic acid  
abietic acid  
10 itaconic acid  
lactic acid  
glycolic acid  
malic acid  
maleic acid  
15 cinnamic acid  
para-hydroxybenzoic acid  
methacrylic acid  
oxalic acid  
myristic acid  
20 palmitic acid  
tert-pentanoic acid  
phenylacetic acid  
mandelic acid  
sebacic acid  
25 tallow fatty acids  
hydrogenated tallow fatty acids  
tartaric acid  
trichloroacetic acid  
2,4,5-trichlorophenoxyacetic acid  
30 undecylenic acid  
crotonic acid  
pelargonic acid  
acetoacetic acid  
para-nitrobenzoic acid  
35 ascorbic acid  
nitrilotriacetic acid  
naphthenic acids  
1-naphthoic acid  
trimellitic acid

19. A method as described in claim 12 wherein the mercaptans are selected from the group consisting of dodecyl mercaptan, t-dodecyl mercaptan, isodecyl mercaptan, octyl mercaptan, octadecyl mercaptan.

5 20. A method as described in claim 12 wherein the alcohols are selected from the group consisting of

triphenylmethanol

trichloroethanol

trifluoroethanol

3 2-nitroethanol

2-chloroethanol

2,2-dichloroethanol

2-methoxyethanol

2-chlorocyclohexanol

5 ortho-chlorobenzyl alcohol



European Patent  
Office

# EUROPEAN SEARCH REPORT

0046947

Application number

EP 81 10 6520

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 1)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
PA	GB - A - 1 177 636 (I.C.I.) * Whole document *	1,2,4- 8,10- 13,17	C 07 B 29/00 C 08 G 65/28 65/26 B 01 J 23/02 C 07 C 41/03 43/13 45/64 85/24 102/00 148/00 51/357
	EP - A - 0 026 546 (UNION CARBIDE) * Examples; claims *	1,2,4- 8,10- 13	
A	US - A - 3 761 523 (R.E. REID et al.) * Whole document *	7,8, 10-13	TECHNICAL FIELDS SEARCHED (Int. Cl. 1)  C 07 B 29/00 C 08 G 65/26 C 07 C 41/03 43/13 C 08 G 65/28 B 01 J 23/02
A	US - A - 4 210 764 (K. YANG et al.) * Claims *	1-13	
PA	US - A - 4 223 164 (K. YANG et al.) * Claims *	1-13	CATEGORY OF CITED DOCUMENTS  X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
A	US - A - 3 839 212 (F.C. McCOY) * Column 3, line 3 - column 4, line 19 *	1	
The present search report has been drawn up for all claims			&. member of the same patent family. corresponding document
Place of search		Date of completion of the search	Examiner

EPO Form 1503.1 06.78 23-11-1981 FLETCHER

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

- |   |  |      |
|---|--|------|
| A | JP, A, 58-185621 (Shell Internationale Research Maatschappij N.V.),<br>October 29, 1983 (29. 10. 83),<br>Line 3, lower left column, page 1 to<br>line 17, upper left column, page 3,<br>line 7, upper right column to<br>line 14, lower left column, page 7<br>& EP, B1, 99445 & US, A, 4472560<br>& DE, C3, 3378269 | 1-10 |
| A | JP, A, 58-185433 (Shell Internationale Research Maatschappij N.V.),<br>October 29, 1983 (29. 10. 83),  | 1-10 |

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>1</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers . . . because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claim numbers . . . because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claim numbers . . . because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>2</sup>

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

## Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Line 4, lower left column, page 1 to  
line 13, upper left column, page 3  
& EP, B1, 90444 & US, A, 4477589  
& DE, C3, 3378690

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>1</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers . . . because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claim numbers . . . because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claim numbers . . . because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>2</sup>

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims: it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.  
☐ No protest accompanied the payment of additional search fees



**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☒ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY.
- ☐ OTHER: \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**

**THIS PAGE BLANK (USPTO)**